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09/892,586	06/27/2001	Paul Turner	1086.2002-001	2279

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EXAMINER	
SHARON, AYAL I	
ART UNIT	**PAPER NUMBER**
2123	

DATE MAILED: 01/26/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	**Application No.** 09/892,586	**Applicant(s)** TURNER ET AL.	
	Examiner Ayal I. Sharon	**Art Unit** 2123	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *28 October 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-24* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *22-24* is/are allowed.

6)☒ Claim(s) *1-5,7-15 and 17-21* is/are rejected.

7)☒ Claim(s) *6 and 16* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *13 August 2001* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

DETAILED ACTION

Introduction

1. Claims 1-24 of U.S. Application 09/892,586, originally filed on 06/27/2001 are still pending. The case claims priority to provisional application 60/214,875, filed on 06/29/2000.
2. In the amendment after RCE, Claims 1, 11, and 21 have been amended to recite the limitation that appears in each of claims 22, 23, and 24, and was previously indicated as being allowable subject matter.
3. After a further search, relevant new art has been found. The new art has been applied in new art rejections.

Allowable Subject Matter

4. The following are statements of reasons for the indication of allowable subject matter.
5. The relevant prior art is:
   - Lightbody, et al. "Neural Network Modelling of a Polymerisation Reactor". Int'l Conf. on Control, 1994. March 21-24, 1994. Vol.1, pp.237-242. (Hereinafter "**Lightbody**").
   - Weisstein, Eric W. "Hyperbolic Tangent." From MathWorld. © 1999 CRC Press. http://mathworld.wolfram.com/HyperbolicTangent.html.

(Hereinafter "**Weisstein**").

6. **Dependent Claims 6 and 16 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.**

7. In regards to Claims 6 and 16, the Lightbody reference expressly teaches the use of "hyperbolic tangent nodes" in a non-linear neural network used for polymer process control (See Lightbody, p.239, right column, next-to-last paragraph). Examiner interprets that these nodes perform the same purpose as the claimed "transfer function" in the non-linear network model claimed in Claim 16. However, Lightbody does not expressly teach the use of "the log of a hyperbolic cosine function" as in the limitations of Claim 16:

> 6. The method of Claim 5, wherein the non-linear transfer function includes the log of a hyperbolic cosine function.
>
> 16. The computer apparatus of Claim 15, wherein the non-linear transfer function includes the log of a hyperbolic cosine function.

Weisstein teaches at the bottom of p.2 that the integral of hyperbolic tangent equals the natural log of hyperbolic cosine, plus some constant. However, while Lightbody teach the use of "hyperbolic tangent nodes", Lightbody is silent in regards to an integration, summation, or accumulation of the hyperbolic tangent function. Examiner therefore finds that there is no motivation to combine the two references.

8. **Independent Claims 22-24 are allowed for the same reasons detailed above.**

9. Claim 22 recites the following limitations:

22. A computer-implemented method for building a model for modeling a polymer process, said method comprising the steps of:

specifying a base non-linear function for an initial model generally corresponding to the polymer process to be modeled, the initial model including an initial input and an initial output and the base non-linear function including **a log of a hyperbolic cosine function;**

constructing a non-linear network model based on the initial model and including the base non-linear function, the non-linear network model having multiple inputs based on the initial input and a global behavior for the non-linear network model as a whole that conforms generally to the initial output; and

calibrating the non-linear network model based on empirical inputs by using a bound on a derivative of the base non-linear function to constrain parameters of the model to produce a constrained model with global behavior the constrained model providing precision control of the non-linear empirical process.

10. Claim 23 recites the following limitations:

23. A computer apparatus for building a model for modeling a polymer process; comprising:

a model creator for specifying a base non-linear function for an initial model generally corresponding to the polymer process to be modeled, the initial model including an initial input and an initial output and the base non-linear function including **a log of a hyperbolic cosine function;**

a model constructor coupled to the model creator for constructing a non linear network model based on the initial model and including the base non linear function, the non-linear network model having multiple inputs based on the initial input and a global behavior for the non-linear network model as a whole that conforms generally to the initial output; and

a calibrator coupled to the model constructor for calibrating the non linear network model based on empirical inputs by using a bound on a derivative of the base non-linear function to constrain parameters of the model in order to produce a constrained model with global behavior, the constrained model providing optimized approximations to a process controller for controlling the polymer process.

11. Claim 24 recites the following limitations:

24. A computer program product that includes a computer usable medium having computer program instructions stored thereon for modeling a polymer process, such that the computer program instructions, when performed by a digital processor, cause the digital processor to:

specify a base non-linear function for an initial model generally corresponding to the polymer process to be modeled, the initial model including an initial input and an initial output and the base non-linear function including **a log of a hyperbolic cosine function;**

construct a non-linear network model based on the initial model and

including the base non-linear function, the non-linear network model having multiple inputs based on the initial input and a global behavior for the non-linear network model as a whole that conforms generally to the initial output; and

calibrate the non-linear network model based on empirical inputs by using a bounded derivative of the base non-linear function to constrain the parameters of the model in order to produce a constrained model with global behavior, the constrained model providing optimized approximations to a process controller for controlling the polymer process.

Claim Rejections - 35 USC § 102

12. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

13. The prior art used for these rejections is as follows:

- Lightbody, et al. "Neural Network Modelling of a Polymerisation Reactor". Int'l Conf. on Control, 1994. March 21-24, 1994. Vol.1, pp.237-242. (Hereinafter "**Lightbody**").

14. The claim rejections are hereby summarized for Applicant's convenience. The detailed rejections follow.

15. Claims 1-5, 7-15, and 17-21 rejected under 35 U.S.C. 102(b) as being anticipated by Lightbody.

16. In regards to Claim 1, Lightbody teaches the following limitations:

1. A method for modeling a non-linear empirical process, comprising the steps of

creating an initial model generally corresponding to the non-linear empirical process to be modeled, the initial model having a base non-linear function an initial input and an initial output;

(See Lightbody, especially: pp.239-241, "Neural Predictive Modeling")

Lightbody teaches on p.239, right column: "The model structure of equation (2) was proposed, with a Multi-layer Perception network utilized to form the nonlinear function."

> constructing a non-linear network model based on the initial model, the non-linear network model having multiple inputs based on the initial input and a global behavior for the non-linear network model as a whole that conforms generally to the initial output; and

(See Lightbody, especially: pp.239-241, "Neural Predictive Modeling")

Lightbody teaches on p.239, right column: "The batch cost is determined as in equation (3), where w represents network weight vector, N is the size of the training set and y(i) and y(i) are the neural and desired outputs respectively."

> calibrating the non-linear network model based on empirical inputs by using a bound on a derivative of the base non-linear function to constrain parameters of the model to produce a constrained model with global behavior of the non-linear network model, the constrained model providing precision control of the non-linear empirical process.

(See Lightbody, especially: pp.239-241, "Neural Predictive Modeling")

Lightbody teaches on p.239, left column: "The weight upgrade equation, utilizing the memoryless BFGS algorithm as summarized below, where the gradient of the cost, g is determined at each instant using batch back-propagation."

Examiner interprets that the gradient of the cost corresponds to the claimed bounded derivative.

17. In regards to Claim 2, Lightbody teaches the following limitations:

> 2. The method of Claim 1, wherein the step of creating the initial model includes specifying a general shape of a gain trajectory for the non-linear empirical process.

(See Lightbody, especially: pp.239-241, "Neural Predictive Modeling")

Lightbody teaches on p.239, right column: "It is assumed that the number of hidden units was fixed as ten hyperbolic nodes."

18. In regards to Claim 3, Lightbody teaches the following limitations:

> 3. The method of Claim 1, wherein the step of creating the initial model includes specifying a non-linear transfer function suitable for use in approximating the non-linear empirical process.

(See Lightbody, especially: pp.239-241, "Neural Predictive Modeling")

Lightbody teaches on p.239, right column: "It is assumed that the number of hidden units was fixed as ten hyperbolic nodes."

19. In regards to Claim 4, Lightbody teaches the following limitations:

> 4. The method of Claim 3, wherein the non-linear network includes interconnected transformation elements and the step of constructing the non-linear network includes incorporating the non-linear transfer function into at least one transformation element.

(See Lightbody, especially: pp.239-241, "Neural Predictive Modeling")

Lightbody teaches on p.239, right column: "It is assumed that the number of hidden units was fixed as ten hyperbolic nodes."

20. In regards to Claim 5, Lightbody teaches the following limitations:

> 5. The method of Claim 4, wherein the step of optimizing the non-linear model includes setting constraints by taking a bounded derivative of the non-linear transfer function.

(See Lightbody, especially: pp.239-241, "Neural Predictive Modeling")

Lightbody teaches on p.239, left column: "The weight upgrade equation, utilizing the memoryless BFGS algorithm as summarized below, where the gradient of the cost, g is determined at each instant using batch back-propagation."

Examiner interprets that the gradient of the cost corresponds to the claimed bounded derivative.

21. In regards to Claim 7, Lightbody teaches the following limitations:

> 7. The method of Claim 1, wherein the non-linear network model is based on a layered network architecture having a feedforward network of nodes with input/output relationships to each other, the feedforward network having transformation elements; each transformation element having a non-linear transfer function, a weighted input coefficient and a weighted output coefficient; and the step of calibrating the non-linear network model includes constraining the global behavior of the non-linear network model to a monotonic transformation based on the initial input by pairing the weighted input and output coefficients for each transformation element in a complementary manner to provide the monotonic transformation.

(See Lightbody, especially: pp.239-241, "Neural Predictive Modeling")

22. In regards to Claim 8, Lightbody teaches the following limitations:

> 8. The method of Claim 1, wherein the step of optimizing the non-linear network

model comprises adjusting the optimizing based on information provided by an advisory model that represents another model of the non-linear empirical process that is different from the initial model, the non-linear network model, and the constrained model.

(See Lightbody, especially: pp.239-241, "Neural Predictive Modeling")

23. In regards to Claim 9, Lightbody teaches the following limitations:

9. The method of Claim 8, wherein the advisory model is a first principles model of the non-linear empirical process.

(See Lightbody, especially: pp.239-241, "Neural Predictive Modeling")

24. In regards to Claim 10, Lightbody teaches the following limitations:

10. The method of Claim 1, wherein the non-linear empirical process is part of a greater process, and the method further includes the step of deploying the constrained model in a controller that controls the greater process.

(See Lightbody, especially: pp.239-241, "Neural Predictive Modeling")

25. **Claims 11-20 are rejected based on the same reasoning as claims 1-10. Claims 11-20 are computer apparatus claims that recite limitations equivalent to those recited in method claims 1-10 and taught throughout Lightbody.**

26. **Claim 21 is rejected based on the same reasoning as claim 1. Claim 21 is a computer program product claim that recites limitations equivalent to those recited in method claim 1 and taught throughout Lightbody.**

Response to Amendment

Re: Claim Rejections - 35 USC § 101

27. Examiner finds that the newly amended claims 1, 11, 21, and 22-24 recite concrete, useful, and tangible results. The 35 USC § 101 rejections of these claims, and their dependant claims, have been withdrawn.

Re: Claim Rejections - 35 USC § 102 – Wassick Reference

28. Examiner finds that the claim amendments overcome the 35 USC § 102 rejections based on the Wassick reference. The rejections have been withdrawn.

Conclusion

29. The following prior art, made of record and not relied upon, is considered pertinent to applicant's disclosure.

30. U.S. Patent 6,862,562 to Treiber et al. (See especially col.9, lines 22-36 that appear to discuss the same field of invention as the instant claims).

31. Hahn, K. "Karl's Calculus Tutor – Section 11: Methods of Integration." © 2001. pp.1-12. http://www.karlscalculus.org/hyper.html. (On pp.6-7, this reference shows a relationship between arccosh and arctanh, but not between tanh and log cosh).

32. Hahn, K. "Inverse Hyperbolic Functions" © 2001. pp.1-2. http://www.karlscalculus.org/hyper.html. (This is a reprint of pp.6-7 of the previous reference so as to show the formulas more clearly).

33. Weisstein, Eric W. "Hyperbolic Cosine." From MathWorld. © 1999 CRC Press. http://mathworld.wolfram.com/HyperbolicCosine.html. (Teaches about hyperbolic cosine).

34. Weisstein, Eric W. "Hyperbolic Functions." From MathWorld. © 1999 CRC Press. http://mathworld.wolfram.com/HyperbolicFunctions.html. (Teaches about hyperbolic functions).

35. Weisstein, Eric W. "Inverse Hyperbolic Functions." From MathWorld. © 1999 CRC Press. http://mathworld.wolfram.com/InverseHyperbolicFunctions.html. (Teaches about inverse hyperbolic functions).

36. Sloughter, Dan. "Section 6.7: Hyperbolic Functions". Difference Equations to Differential Equations. © 2000. http://math.furman.edu/~dcs/book/c6pdf/sec67.pdf. (Teaches about hyperbolic functions).

37. Muliang, Zhong et al. "System Identification Using Neural Networks and Its Application to Plasticating Extruders." Proc. IEEE TENCON '93. Oct. 19-21, 1993. Vol.2, pp.862-865. (Teaches the use of neural network as a controller in polymer processing.)

38. Wang, X.A. et al. "Artificial Neural Network Model-Based Run-to-Run Process Controller." IEEE Transactions on Components, Packaging, and Manuf. Technology. Jan. 1996. Vol.19, Issue 1, pp.19-26. (Teaches the use of neural network as a controller in batch semiconductor silicon manufacturing.)

39. Sentoni, G.B. et al. "Model Reduction for Nonlinear DABNet Models." Proc. of 1999 American Control Conf. June 2-4, 1999. Vol.3, pp.2052-2056. (Teaches the use of a non-linear dynamic system in the polymer control process).

Correspondence Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ayal I. Sharon whose telephone number is

(571) 272-3714. The examiner can normally be reached on Monday through Thursday, and the first Friday of a biweek, 8:30 am – 5:30 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Leo Picard can be reached at (571) 272-3749.

Any response to this office action should be faxed to (571) 273- 8300, or mailed to:

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Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Tech Center 2100 Receptionist, whose telephone number is (571) 272-2100.

Ayal I. Sharon
Art Unit 2123
January 21, 2006

L. P. Picard

LEO PICARD
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2100